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ABSTRACT

This document provides the framework for a postsecondary sheet metal program of instruction. A foreword provides guidelines that were used in developing the program and should be considered in compiling and revising course syllabi and daily lesson plans at the local level. A description of the sheet metal programs (building trades sheet metal work and precision sheet metal work) is followed by a suggested course sequence and baseline competencies for sheet metal programs. The vocational-technical courses in the sequence follow. Each has been written using a common format that includes the following components: course name, course abbreviation, classification (vocational-technical core, vocational-technical elective, related academic course, academic core), description, prerequisites, and competencies and suggested objectives. These sheet metal courses are included: orientation and shop safety; measurement; methods of layout I; hand processes I; machine processes I; methods of layout II; hand processes II; sheet metal welding; machine processes II; special project in sheet metal; and work-based learning in sheet metal. One related vocational-technical course is provided: principles of computer-assisted design. A list of recommended tools and equipment follows. Appendixes include recommended academic topics for communications, mathematics, and science; list of workplace skills for the 21st century; and sample student competency profile for sheet metal programs. (YLB)

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ED 400 415

Mississippi Curriculum Framework for Sheet Metal

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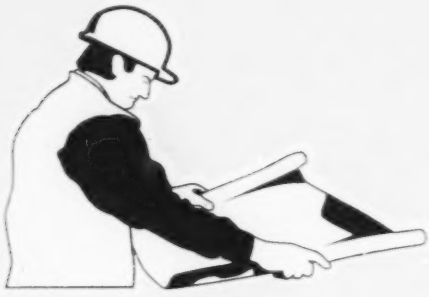

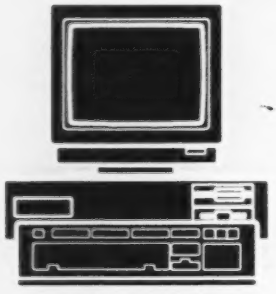

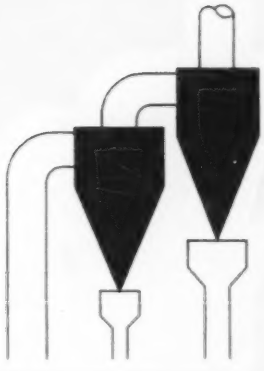

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Postsecondary
Vocational and Technical Education
1996

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July 30, 1996

MISSISSIPPI

CURRICULUM FRAMEWORK

FOR

SHEET METAL PROGRAMS

(PROGRAM CIP: 48.0506 - Sheet Metal Worker)

July 30, 1996

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FOREWORD

In order to survive in today's global economy, businesses and industries have had to adopt new practices and procedures. Total quality management, statistical process control, participatory management, and other concepts of high performance work organizations are practices by which successful companies survive. Employers now expect their employees to be able to read, write, and communicate effectively; solve problems and make decisions; and interact with the technologies that are prevalent in today's workplace. Vocational-technical education programs must also adopt these practices in order to provide graduates who can enter and advance in the changing work world.

The curriculum framework in this document reflects these changes in the workplace and a number of other factors that impact on local vocational-technical programs. Federal and state legislation calls for articulation between high school and community college programs, integration of academic and vocational skills, and the development of sequential courses of study that provide students with the optimum educational path for achieving successful employment. National skills standards, developed by industry groups and sponsored by the U. S. Departments of Education and Labor, provide vocational educators with the expectations of employers across the United States. All of these factors are reflected in the framework found in this document.

Each postsecondary program of instruction consists of a program description and a suggested sequence of courses which focus on the development of occupational competencies. Each vocational-technical course in this sequence has been written using a common format which includes the following components:

- Course Name - A common name that will be used by all community/junior colleges in reporting students.

- Course Abbreviation - A common abbreviation that will be used by all community/junior colleges in reporting students.

- Classification - Courses may be classified as:
  - Vocational-technical core - A required vocational-technical course for all students.
  - Vocational-technical elective - An elective vocational-technical course.
  - Related academic course - An academic course which provides academic skills and knowledge directly related to the program area.
  - Academic core - An academic course which is required as part of the requirements for an Associate degree.

- Description - A short narrative which includes the major purpose(s) of the course and the recommended number of hours of lecture and laboratory activities to be conducted each week during a regular semester.

- Prerequisites - A listing of any prerequisite courses that must be taken prior to or on enrollment in the course.

- Competencies and Suggested Objectives - A listing of the competencies (major concepts and performances) and of the suggested student objectives that will enable students to demonstrate mastery of these competencies.

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75 percent of the time allocated to each course. For example, in a four semester hour course consisting of 30 hours lecture and 120 hours of laboratory activities, approximately 22 hours of lecture and 90 hours of lab should be taken by the competencies and suggested objectives identified in the course framework. The remaining 25 percent of each course should be developed at the local district level and may reflect:
  - Additional competencies and objectives within the course related to topics not found in the State framework, including activities related to specific needs of industries in the community college district.
  - Activities which develop a higher level of mastery on the existing competencies and suggested objectives.
  - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed/revised.
  - Activities which implement components of the Mississippi Tech Prep initiative, including integration of academic and vocational-technical skills and coursework, school-to-career transition activities, and articulation of secondary and postsecondary vocational-technical programs.
  - Individualized learning activities, including worksite learning activities, to better prepare individuals in the courses for their chosen occupational area.

- Sequencing of the course within a program is left to the discretion of the local district. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors.

- Programs that offer an Associate of Applied Science degree must include a minimum 15 semester credit hour academic core. Specific courses to be taken within this core are to be determined by the local district. Minimum academic core courses are as follows:
  - 3 semester credit hours — Math/Science Elective
  - 3 semester credit hours — Written Communications Elective
  - 3 semester credit hours — Oral Communications Elective
  - 3 semester credit hours — Humanities/Fine Arts Elective
  - 3 semester credit hours — Social/Behavioral Science Elective

  It is recommended that courses in the academic core be spaced out over the entire length of the program, so that students complete some academic and vocational-technical courses each semester. Each community/junior college has the discretion to select the actual courses that are required to meet this academic core requirement.

- In instances where secondary programs are directly related to community and junior college programs, competencies and suggested objectives from the high school programs are listed as Baseline Competencies. These competencies and objectives reflect skills and knowledge that are directly related to the community and junior college vocational-technical program. In adopting the curriculum framework, each community and junior college is asked to give assurances that:
  - students who can demonstrate mastery of the Baseline Competencies do not receive duplicate instruction, and
  - students who cannot demonstrate mastery of this content will be given the opportunity to do so.

- The roles of the Baseline Competencies are to:
  - Assist community/junior college personnel in developing articulation agreements with high schools, and
  - Ensure that all community and junior college courses provide a higher level of instruction than their secondary counterparts

- The Baseline Competencies may be taught as special "Introduction" courses for 3-6 semester hours of institutional credit which will not count toward Associate degree requirements. Community and junior colleges may choose to integrate the Baseline Competencies into ongoing courses in lieu of offering the "Introduction" courses or may offer the competencies through special projects or individualized instruction methods.

- Technical elective courses have been included to allow community colleges and students to customize programs to meet the needs of industries and employers in their area.

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July 30, 1996

PROGRAM DESCRIPTION

SHEET METAL PROGRAMS

The Sheet Metal instructional program prepares individuals to lay out, fabricate, erect or install, and maintain items made of steel, copper, stainless steel, and aluminum using hand tools and machines such as cornice brakes, forming rolls, and squaring shears. Instruction in sheet metal work can be placed in two basic categories: (1) Building Trades Sheet Metal Work and (2) Precision Sheet Metal Work.

The building trades sheet metal workers construct and install various types of ducts which are connected to form systems through which air is passed. These systems are referred to as heating, ventilating, and air conditioning systems. They are needed in homes, stores, apartments, offices, schools, hotels, shops, airplanes, and trains. Building trades sheet metal workers make and install gutters, down spouts, blow pipes, and industrial exhaust systems.

Precision or production sheet metal workers employed in industry produce parts used in various types of products and equipment for aircraft, missiles, electronics, communications, data processing, computers, defense, military, photography, radiography, restaurants, food processing, air handling, laboratories, appliances, spaceships, shipbuilding, sign manufacturing, and transportation.

Upon the successful completion of a minimum of 32 semester hours of college credit, the student will be eligible for a Certificate in Sheet Metal Work.

SHEET METAL PROGRAMS

SUGGESTED COURSE SEQUENCE*

Baseline Competencies for Sheet Metal**

FIRST YEAR

2 sch	Orientation and Shop Safety (SMV 1112)	6 sch	Methods of Layout II (SMV 1326)
2 sch	Measurement (SMV 1212)	4 sch	Hand Processes II (SMV 1424)
5 sch	Methods of Layout I (SMV 1315)	3 sch	Vocational-Technical Elective*
4 sch	Hand Processes I (SMV 1414)	3 sch	Sheet Metal Welding (SMV 1613)
3 sch	Machine Processes I (SMV 1513)		
16 sch		16 sch	

* Students who lack entry level skills in math, English, science, etc., will be provided related studies.

** Baseline competencies are taken from the high school Metal Trades program. Students who can document mastery of these competencies should not receive duplicate instruction. Students who cannot demonstrate mastery will be required to do so.

* TECHNICAL ELECTIVES:

3 sch	Machine Processes II (SMV 1523)
1-3 sch	Special Project in Sheet Metal [SMV 291(1-3)]
1-6 sch	Work-Based Learning in Sheet Metal [SMV 292(1-6)]
3 sch	Principles of CAD (DDT 1313)

SECTION I:

BASELINE COMPETENCIES

BASELINE COMPETENCIES FOR SHEET METAL PROGRAMS

The following competencies and suggested objectives are taken from the publication *Mississippi Curriculum Framework for Metal Trades*. These competencies and objectives represent the baseline which was used to develop the community/junior college Sheet Metal courses. Students enrolled in postsecondary courses should either (1) have documented mastery of these competencies, or (2) be provided with these competencies before studying the advanced competencies in the Sheet Metal program.

Baseline competencies may be integrated into existing courses in the curriculum or taught as special "Introduction" courses. The "Introduction" courses may be taught for up to six semester hours of institutional credit and may be divided into two courses. If the Baseline Competencies are to be taught as "Introduction" courses, each course should be at least 3 credit hours. The following course number(s) and description should be used:

Course Name(s): Introduction to Sheet Metal, Introduction to Sheet Metal I, or Introduction to Sheet Metal II

Course Abbreviation(s): SMV 100(3-6), SMV 1013, SMV 1023

Classification: Vocational-Technical Core

Description: These courses contain the baseline competencies and suggested objectives from the high school Metal Trades curriculum which directly relate to the community college Sheet Metal program. The courses are designed for students entering the community college who have had no previous training or documented experience in the field. (3-6 semester hours based upon existing skills for each student. May be divided into 2 courses for a maximum total of 6 hours of institutional credit.)

Competencies and Suggested Objectives:

1. Demonstrate the student school handbook and classroom policies.
   a. Identify policies found in the school handbook.
   b. Identify classroom rules and policies.
   Related Academic Topics (See Appendix A): C1, C2, C3
   Workplace Skills (See Appendix B): WP2, WP6
2. Review occupational and leadership opportunities in metal trades.
   a. Investigate occupational opportunities in the local area.
   b. Update the student's Career/Educational Plan.
   c. Describe leadership opportunities available from student youth organizations in the school and community, including VICA.

Related Academic Topics (See Appendix A): C1, C4, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6

3. Demonstrate safety procedures used in metal trades.
   a. Apply safety rules for personal and general shop safety including eye (State Eye Safety Law provisions), ear, and body protection; general rules of shop conduct; and the use of safety color coding in metal trades.
   b. Apply general safety rules for tool and shop equipment use including use of hand tools, air and electric power tools, and other shop equipment.
   c. Apply rules and procedures associated with fire safety including procedures for handling and storing flammable liquids and proper use of fire fighting devices.

   Related Academic Topics (See Appendix A): C2, C4, S5, S6, S8
   Workplace Skills (See Appendix B): WP5
4. Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.
   a. Recognize signal words and symbols that indicate severity of a hazard.
   b. Describe methods for reducing hazardous waste.
   c. Describe procedures for storing hazardous waste.
   d. Interpret data found on a hazardous material safety data sheet.
   e. Describe general safety procedures for first aid and cleanup to follow in case of an accident involving hazardous materials.
   f. Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.

   Related Academic Topics (See Appendix A): C1, C2, C4, S5, S8
   Workplace Skills (See Appendix B): WP2, WP3, WP4, WP5, WP6
5. Calculate measurements using fractions and decimals.
   a. Solve problems using fractions including conversion for performing addition, subtraction, multiplication, and division.
   b. Solve problems using decimals, including the addition, subtraction, multiplication, and division of decimal numbers.

   Related Academic Topics (See Appendix A): C1, C5, M1, M4, M7
   Workplace Skills (See Appendix B): WP1, WP2, WP6
6. Interpret blueprint symbols, abbreviations, alphabet of lines, types of views, and title blocks.
   a. Identify the meaning of common blueprint symbols including concentricity, straightness, perpendicularity, center line, and diameter.
   b. Describe the abbreviations commonly used on blueprints including the following: Cast iron (CI), Cold rolled steel (CRS), Cast steel (CS), Center to center (CC), Counterbore (C' Bore or CB), Countersink (Csk), Diameter (Dia), Finish (F or Fin), Square (SQ), Hexagon (Hex), Inside diameter (ID), Outside diameter (OD), Radius (R or Rad), Required (Req'd or Req), Pitch diameter (PD), Round (Rd), Symmetrical (SYM), Total indicator reading (TIR), Typical (TYP), Parallel (Par), United National Coarse (UNC), Unified National Fine (UNF), and American Standard Taper Pipe (NTP).

c. Identify the alphabet of lines used on blueprints, including object lines, hidden lines, center line, extension line, dimension lines, section lines, cutting plane line, break lines, and phantom line.
d. Identify the types of views shown on blueprints including top, front, and right side.
e. Define the terms "dimension" including size, shape, location, and slots, and "tolerance" including the total variation permitted in the size of a part.
f. Identify methods for showing dimensions and tolerance including linear and angular dimensions and basic size, allowance, and actual size tolerance.
g. Interpret information found in the title block of a blueprint including drawing number, file number, name, sheet, scale, code identification number, signatures, tolerances, and revisions.

Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4
Workplace Skills (See Appendix B): WP1, WP2, WP6

7. Identify and describe safety rules that apply to the pedestal grinder, and perform inspection, maintenance, and grinding operations.
   a. Describe safety rules that apply to the pedestal grinder including wearing safety glasses, standing to side when turning on machine, gap between wheel and rest, conducting ring test when installing wheel, and correct feed.
   b. Inspect and maintain a pedestal grinder including checking a new wheel for cracks, replacing a wheel, and dressing a wheel, and grinding a high speed tool bit and twist drill to specifications.

   Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S4, S5
   Workplace Skills (See Appendix B): WP1, WP2, WP4
8. Identify and describe hand tools, sheet metal machines, and terms used in sheet metal work.
   a. Identify and describe the safe use of specialized hand tools and sheet metal working machines used in sheet metal work including: steel rule, dividers, squares, protractors, American and U.S. Standard metal gauges, metal marking devices, snips, punches, rivet sets, dollies, chisels, hammers, crimpers, hand seamer, dovetailer, files, hacksaw, screwdrivers, pliers, wrenches, pop rivet gun, and hand groover, adjustable bar folder, hand brake (cornice brake), box and pan brake, ring and circle shears, and notcher.
   b. Identify common seams, locks, edges, and notches used in sheet metal work including seams (groove lock, Pittsburgh, standing, soldered, and riveted); locks (drive cleat, S-cleat, standing S-cleat), edges (hem, double hem, standing hem, and wired edge), and notches (corner, lap, duct, 45-degree lap, center Pittsburgh, corner Pittsburgh, and dovetail); identify fasteners used in sheet metal work including rivets, screws, and bolts and nuts; and define basic geometric terms including parallel line layout, radial

line, triangulation, circumference, diameter, radius, pi, area, perimeter, and volume.

Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M7
Workplace Skills (See Appendix B): WP2, WP5

9. Fabricate sheet metal projects as assigned, using various hand tools and sheet metal machines.
   a. Fabricate metal rectangles, metal circles, form cylinders, a simple box, and straight duct to specifications; fabricate 90 degree (square throat and heel), 90 degree elbow (radius throat and heel), and simple offset.
   b. Fold, bend, hem, and make drive clips on a hand brake according to specifications.

   Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S5, S6
   Workplace Skills (See Appendix B): WP2, WP5, WP6
10. Describe the short circuit transfer and spray arc metal transfer process, rules for GMAW electrode selection, uses of the common shielding gases in GMAW, and setup and shutdown of GMAW equipment.
   a. Describe the short circuit transfer and spray arc metal transfer processes.
   b. Describe rules for GMAW electrode selection including short circuit transfer uses of small diameter wires of .035" or larger and the uses of the common shielding gases in GMAW (argon, CO_2, and oxygen).
   c. Set up GMAW equipment, perform short circuit transfer, and shut down equipment.

   Related Academic Topics (See Appendix A): C1, C2, C5, M1, M4, M7, S5, S6
   Workplace Skills (See Appendix B): WP2, WP4, WP5
11. Perform maintenance operations on a bench grinder to manufacturer's specifications and grinding operations to teacher's specifications.
   a. Remove and replace a grinding wheel on a grinding machine according to manufacturer's specifications.
   b. Dress a grinding machine wheel flat according to manufacturer's specifications.
   c. Grind a workpiece flat and parallel according to manufacturer's specifications. Grind a workpiece square, an angular surface, and to dimension according to teacher's specifications.

   Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4
   Workplace Skills (See Appendix B): WP2, WP4, WP5

SECTION II:

CURRICULUM GUIDE

FOR

SHEET METAL PROGRAMS

SHEET METAL COURSES

Course Name: Orientation and Shop Safety

Course Abbreviation: SMV 1112

Classification: Vocational-Technical Core

Description: This course includes an introduction to occupations in the sheet metal industry and an overview of the personal and shop safety practices of the sheet metal industry. (2 sch: 1 hr. lecture, 2 hr. lab)

Prerequisites: None

Competencies and Suggested Objectives:

1. Describe local program and school policies and procedures.
   a. Describe local program and school policies and procedures including dress code, attendance, academic requirements, and discipline.

   Related Academic Topics (See Appendix A): C1, C4, C6
   Workplace Skills (See Appendix B): WP2, WP3, WP6
2. Describe employment opportunities and responsibilities.
   a. Describe employment opportunities including potential earnings, employee benefits, job availability, places of employment, working conditions, and educational requirements.
   b. Describe basic employee responsibilities.

   Related Academic Topics (See Appendix A): C1, C4, C6
   Workplace Skills (See Appendix B): WP2, WP3, WP6
3. Describe personal safety rules for working in the sheet metal industry.
   a. Identify and apply terms and definitions for safety.
   b. Identify provisions of the OSHA Act of 1970.
   c. Identify OSHA inspections and citations.
   d. Identify why citations are given.
   e. Identify accidents, their causes, and their prevention.
   f. Identify general safety procedures.
   g. Identify causes of electrical hazards.
   h. Identify proper methods for moving heavy items.
   i. Identify and apply emergency first aid, if necessary.
   j. Identify and apply ABC's of CPR.
   k. Apply eye safety procedures.
   l. Identify and apply safety rules pertaining to hand and power tools.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3

Course Name: Measurement

Course Abbreviation: SMV 1212

Classification: Vocational-Technical Core

Description: This course includes the selection and correct use of measuring tools, basic mathematics, and blueprint reading of the sheet metal industry. (2 sch: 1 hr. lecture, 2 hr. lab)

Prerequisites: None

Competencies and Suggested Objectives:

1. Demonstrate the ability to use various measuring tools used in the sheet metal industry.
   a. Measure with a steel rule.
   b. Measure with a steel square.
   c. Measure with a circumference rule.
   d. Measure with a semi-circumference rule.
   e. Measure with a swing-blade protractor.
   f. Measure with a micrometer, vernier caliper, and metal thickness gauge as used in sheet metal work.
   g. Measure ferrous metal with sheet metal gauges.
   h. Measure non-ferrous metals with sheet metal gauges.

   Related Academic Topics (See Appendix A): C1, C4, C5, M1, M4, M5
   Workplace Skills (See Appendix B): WP2, WP3
2. Demonstrate the ability to lay out different shapes and calculate unknown volumes and air movements.
   a. Transfer measurements with dividers onto sheet metal.
   b. Measure and divide a line into an equal number of parts.
   c. Measure and divide a circle and profile into an equal number of parts.
   d. Measure and calculate the volume of square tanks.
   e. Measure and calculate the volume of round tanks.
   f. Measure and calculate the volume of air movement (CFM) in square ducts.
   g. Measure and calculate the volume of air movement (CFM) in round pipes.
   h. Use pi (3.1416) to calculate circumference for making round projects.
   i. Use the formula 6.25 to calculate the cut-out for conical caps.
   j. Measure and calculate the free area for conical caps.
   k. Measure and obtain the free area for goosenecks.
   l. Measure and calculate the slope when installing gutter.
   m. Measure and calculate the pitch of a roof.

n. Measure air volume using a velometer.

Related Academic Topics (See Appendix A): C1, C4, C5, M1, M3, M4, M5, M7

Workplace Skills (See Appendix B): WP2, WP3, WP6

3. Demonstrate that ability to perform basic drawing skills.
   a. Measure blueprints using an architectural scale.
   b. Identify the basic symbols used on blueprints.
   c. Read and interpret notes on blueprints.
   d. Measure and transfer measurements using trammels.
   e. Draw circles and arcs with trammels.

   Related Academic Topics (See Appendix A): C1, C2, C4, C5, M4, M5

   Workplace Skills (See Appendix B): WP2, WP3, WP6

Course Name: Methods of Layout I

Course Abbreviation: SMV 1315

Classification: Vocational-Technical Core

Description: This course includes the layout and development of various sheet metal problems using the principles of parallel line and triangulation development. (5 sch: 2 hr. lecture, 6 hr. lab)

Pre/Corequisites: Measurement (SMV 1212)

Competencies and Suggested Objectives:

1. Demonstrate the ability to lay out and develop various sheet metal problems using the principles of parallel line and triangulation development.
   a. Lay out a rectangular sheet metal project.
   b. Lay out a round sheet metal project.
   c. Lay out a transition sheet metal project.
   Related Academic Topics (See Appendix A): C1, C4, C5, M1, M4, M5, M7
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6
2. Demonstrate the ability to lay out and develop the following sheet metal problems using the principles of parallel line:
   a. Construct a rectangular straight duct (one piece construction) - plenum box.
   b. Construct a rectangular square throat and radius heel duct elbow.
   c. Round duct (miter 45 degrees).
   d. Round saddle tap (miter) (same diameters).
   e. Round straight duct.
   f. Flat S – hand and machine.
   g. Bar S (Standing) – machine and hand.
   h. Drive cleat – hand and machine.
   i. Pittsburgh seam – hand and machine.
   Related Academic Topics (See Appendix A): C1, C4, C5, M1, M4, M5, M7
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6
3. Demonstrate the ability to lay out and develop the following sheet metal problems using the principles of triangulation:
   a. Square to round (center taper) (boot box)
   b. Round duct taper (equal and taper).
   c. Rectangular duct transition.
   d. Rectangular radius throat and radius heel duct elbow.
   Related Academic Topics (See Appendix A): C1, C4, C5, M1, M4, M5, M7
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6

Course Name: Hand Processes I

Course Abbreviation: SMV 1414

Classification: Vocational-Technical Core

Description: This course includes the selection and correct and safe use of hand tools in the sheet metal trade. (4 sch: 2 hr. lecture, 4 hr. lab)

Prerequisites: None

Competencies and Suggested Objectives:

1. Demonstrate the ability to perform layout processes.
   a. Scribe a line with a scratch awl and a straight edge.
   b. Mark centers with a center punch and a tinner's hammer.
   c. Mark a location with a prick punch and a tinner's hammer.
   d. Mark centers with an automatic center punch.
   e. Scribe arcs with dividers on sheet metal.
   f. Scribe parallel lines with a tinner's file.
   g. Scribe parallel lines with a combination square.
   h. Scribe irregular arcs with french curves.

   Related Academic Topics (See Appendix A): C1, C4, C5, M1, M4, M5
   Workplace Skills (See Appendix B): WP2, WP3, WP6
2. Demonstrate the ability to utilize the cutout processes.
   a. Cut along a straight line on sheet metal with straight snips.
   b. Cut along a straight line with compound-lever shears.
   c. Cut outside curves, inside curves, and circles with right and left hand aviation snips.
   d. Cut light sheet metal in a vise with flat chisels.
   e. Cut a starting slit with a chisel and flat blade screwdriver.
   f. Punch holes with a solid punch and a hammer.
   g. Drill holes in flat stock with a hand drill.
   h. Cut flat stock with a hacksaw.
   i. Cut round stock with a hacksaw.
   j. Cut angle iron with a hacksaw.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6
3. Demonstrate the ability to do forming processes.
   a. Set down an edge or flatten seams with a tinner's hammer.
   b. Form material with a wood, rubber composition, or rawhide material.
   c. Form a round piece on the conductor stake with a mallet.
   d. Brake pieces to form boxes with hand tongs or hand seamers.
   e. Brake heavy metal in a vise with ball peen hammer.

f. Form single hem with hand tongs or hand seamers.
g. Prepare an edge for grooved seams with hand tongs or hand seamers.
h. Form a radius bend with a stake.
i. Finish an outside grooved seam using a hollow or solid mandrel stake.
j. Form a plain dovetailed seam using straight-cutting aviation snips.
k. Flange an edge on a stake with a tinner's hammer.
l. Shrink an edge on a stake with a tinner's hammer.
m. Flange an edge with a hand dolly and a tinner's hammer.

Related Academic Topics (See Appendix A): C1, C4, C5
Workplace Skills (See Appendix B): WP2, WP3, WP6

4. Demonstrate the ability to use the various fastening processes.
   a. Assemble or disassemble with a flat blade screwdriver.
   b. Assemble or disassemble with a Phillips screwdriver.
   c. Assemble or disassemble with a screw-shooter (¼" magnetic chuck).
   d. Drive, set, and flange rivets with a riveting hammer and a rivet set.
   e. Rivet a seam using a rivet set and riveting hammer.
   f. Hold a pattern in place by applying C-clamps.
   g. Hold a pattern in place by applying parallel clamps.
   h. Drill holes in cement blocks and bricks with a hammer drill.
   i. Install anchors with a pneumatic gun.
   j. Install duct liner tabs using a pinspotter machine.
   k. Install duct liner in square duct using rubber cement (duct glue).
   l. Install foil-back insulation on round pipe using a hand stapler.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6

5. Demonstrate the ability to apply the various finishing processes.
   a. Finish file a rough edge.
   b. Finish an inside groove seam.
   c. Finish corners and edges with files.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6

Course Name: Machine Processes I

Course Abbreviation: SMV 1513

Classification: Vocational-Technical Core

Description: This course includes selection and the correct and safe use of hand and foot operated machines of the sheet metal trade. (3 sch: 1 hr. lecture, 4 hr. lab)

Prerequisites: None

Competencies and Suggested Objectives:

1. Demonstrate the ability to safely use the cornice brake.
   a. Brake thin sheet metal.
   b. Form a mold.
   c. Form the pocket for a Pittsburgh lock.
   d. Form a lock seam.
   e. Fold a single hem.
   f. Fold a double hem.
   g. Form the folds for a grooved seam.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6
2. Demonstrate the ability to safely use the slip-roll forming machine.
   a. Roll cylindrical shapes.
   b. Form tin plates (round bottom for pans).
   c. Roll tapered shapes.
   d. Roll a cylindrical piece with wired edges.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6
3. Demonstrate the ability to safely use the foot squaring shears.
   a. Cut marked sheet metal.
   b. Cut a sheet against the front gauge.
   c. Cut a sheet against the back gauge.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6
4. Demonstrate the ability to safely use the hand combination rotary machine.
   a. Bead by forming a single, ogee, and triple bead.
   b. Crimp a round pipe and bead cylindrically-shaped cones.
   c. Turn by forming an edge for wiring and using a gauge for scoring or creasing an edge.
   d. Burr a disc and an edge on a cylinder.

Related Academic Topics (See Appendix A): C1, C4, C5
Workplace Skills (See Appendix B): WP2, WP3, WP6

5. Demonstrate the ability to safely use the drill press.
   a. Drill flat plates.
   b. Drill round stock.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6
6. Demonstrate the ability to safely use the bench or floor grinders.
   a. Grind flat stock.
   b. Grind round stock.
   c. Grind points and edges on tools.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6
7. Demonstrate the ability to safely use the disc sanders and buffers.
   a. Grind welds.
   b. Buff aluminum.
   c. Buff stainless steel.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6
8. Demonstrate the ability to safely use the box and pan brake machine.
   a. Form rectangular pans.
   b. Form a radius bend.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6
9. Demonstrate the ability to safely use the Pittsburgh machine.
   a. Form a Pittsburgh lock.
   b. Form a drive lock.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6
10. Demonstrate the ability to safely use a spot welder.
    a. Spot weld galvanized iron.
    b. Spot weld black iron.
    c. Spot weld aluminum.

    Related Academic Topics (See Appendix A): C1, C4, C5
    Workplace Skills (See Appendix B): WP2, WP3, WP6
11. Demonstrate the ability to safely use the metal cutting band saw.
    a. Cut straight lines in flat sheet metal.
    b. Cut arcs and circles in flat sheet metal.

    Related Academic Topics (See Appendix A): C1, C4, C5
    Workplace Skills (See Appendix B): WP2, WP3, WP6
12. Demonstrate the ability to safely use the setting down machine.
    a. Set down a single seam.
    b. Set down a double seam.

Related Academic Topics (See Appendix A): C1, C4, C5
Workplace Skills (See Appendix B): WP2, WP3, WP6

13. Demonstrate the ability to safely use the easy edger.
    a. Make 90 degree bend for radius duct elbow to go inside Pittsburgh seam.

    Related Academic Topics (See Appendix A): C1, C4, C5
    Workplace Skills (See Appendix B): WP2, WP3, WP6
14. Demonstrate the ability to safely use the turret punch.
    a. Punch hole in a drip pan.
    b. Punch holes of different diameters in a fabricated part.

    Related Academic Topics (See Appendix A): C1, C4, C5
    Workplace Skills (See Appendix B): WP2, WP3, WP6

Course Name: Methods of Layout II

Course Abbreviation: SMV 1326

Classification: Vocational-Technical Core

Description: This course is a continuation of Methods of Layout I to include radial line layout and architectural/roofing sheet metal and specialty sheet metal. (6 sch: 3 hr. lecture, 6 hr. lab)

Prerequisites: Methods of Layout I (SMV 1315)

Competencies and Suggested Objectives:

1. Demonstrate the ability to safely fabricate and install the following architectural/roofing sheet metal:
   a. Batten seam metal roof panel, batten and cap.
   b. Standing seam metal roof panel.
   c. Metal flat-lock roof panel.
   d. Ogee gutter.
   e. Half-round gutter.
   f. Rectangular downspout/conductor.
   g. Offset in rectangular downspout/conductor.
   h. Conductor head.
   i. Flashing.
   j. Coping.
   k. Gravel stop facia.
   l. Metal siding panel.
   m. Louvers.
   n. Column covers.
   o. Metal ceiling panel.

   Related Academic Topics (See Appendix A): C1, C4, C5, M4, M5, M7
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6
2. Demonstrate the ability to safely fabricate and install the following specialty sheet metal:
   a. Rectangular single-blade damper in frame.
   b. Rectangular multi-blade damper in frame.
   c. Hamper.
   d. Cyclone dust collector.
   e. Helical (spiral) chute.
   f. Rectangular tube.
   g. Round tube.
   h. Hollow metal letter.
   i. Metal sign.

j. Round duct support saddle (floor mounted).
k. Commercial vent hoods.
l. Commercial two-compartment sink.

Related Academic Topics (See Appendix A): C1, C4, C5, M4, M5, M7
Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6

3. Demonstrate the ability to lay out and develop the following sheet metal problems using the principles of radial line.
   a. Roof jack on 5/12 pitch.
   b. Offset round to round.

   Related Academic Topics (See Appendix A): C1, C4, C5, M4, M5, M7
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6

Course Name: Hand Processes II

Course Abbreviation: SMV 1424

Classification: Vocational-Technical Core

Description: This course is a continuation of Hand Processes I and includes the selection and correct and safe use of the specialty hand and power tools of the sheet metal trade. (4 sch: 2 hr. lecture, 4 hr. lab)

Prerequisites: Hand Processes I (SMV 1414)

Competencies and Suggested Objectives:

1. Demonstrate the ability to safely determine and make various layouts.
   a. Scribe arcs with trammel points.
   b. Scribe parallel lines with a marking gauge.
   Related Academic Topics (See Appendix A): C1, C4, C5, M4, M5, M7
   Workplace Skills (See Appendix B): WP2, WP3, WP6
2. Demonstrate the ability to safely make cutouts of various shapes and materials.
   a. Cut wire with pliers or side cutters.
   b. Cut flat stock with a chisel.
   c. Cut sheet metal with an electric nibbler and uni-shear.
   d. Punch holes with a hollow punch and a hammer.
   e. Punch holes with a hand punch.
   f. Cut out rivets with a punch.
   g. Use electric portable band saw to cut notches on angle iron to make inside and outside frames.
   Related Academic Topics (See Appendix A): C1, C4, C5, M4
   Workplace Skills (See Appendix B): WP2, WP3, WP6
3. Demonstrate the ability to safely form various special projects.
   a. Form a square piece on the breakdown or needle case stake with a mallet.
   b. Form a round piece on the needle case stake with a mallet.
   c. Form a conical piece on the blowhorn with a mallet.
   d. Form a conical piece on the candle mold stake with a mallet.
   e. Brake a piece of sheet metal at a 90 degree angle, with a piece of angle iron, C-clamp, and mallet.
   f. Form a double hem with hand tongs or hand seamers.
   g. Fit a tee using hand snipes.
   h. Wire straight edges before a piece is formed.
   i. Wire an inside or outside radius on a flat piece.
   j. Wire a square or rectangular piece after it is formed.
   k. Wire a tapered piece after it is formed.

l. Double seam corners on a square or rectangular piece with hand seamers and stakes.
m. Set down Pittsburgh seam with a duct hammer.
n. Form a hammer lock on the hand brake.
o. Form small conical shapes using an anvil.
p. Form scrolls with small band iron using an anvil.

Related Academic Topics (See Appendix A): C1, C4, C5, M4, M5, M7
Workplace Skills (See Appendix B): WP2, WP3, WP6

4. Demonstrate the ability to safely use fastening techniques.
   a. Solder a lap seam with a soldering copper.
   b. Forge a soldering copper.
   c. Solder a groove seam with a soldering copper.
   d. Solder a seam with soft solder and an oxyacetylene torch.
   e. Solder a seam with soft solder and a propane torch.
   f. Install pop rivets using a hand pop rivet gun.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6

5. Demonstrate the ability to safely finish welds.
   a. Grind welds using a nine-inch hand disk grinder.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP6

Course Name: Sheet Metal Welding

Course Abbreviation: SMV 1613

Classification: Vocational-Technical Core

Description: This course includes the selection and correct use of welding machines such as manual metal arc, gas metal arc welding (GMAW), oxyacetylene, shielded metal arc (SMAW), and plasma arc cutting (PAC) as used in the sheet metal trade. (3 sch: 1 hr. lecture, 4 hr. lab)

Prerequisites: None

Competencies and Suggested Objectives:

1. Demonstrate the ability to safely use gas metal arc welding (GMAW).
   a. List the advantages and limitations of gas metal arc welding (GMAW).
   b. Describe principles of GMAW for 10 through 16 gauge sheet metal welding.
   c. Describe applications of GMAW for 10 through 16 gauge sheet metal welding.
   d. State rules of thumb for GMAW electrode selection for 10 through 16 gauge sheet metal welding.
   e. State the uses of common shielding gases in GMAW for 10 through 16 gauge sheet metal welding.
   f. Set up and shut down GMAW equipment for short circuit transfer on 10 through 16 gauge sheet metal.
   g. Construct a butt joint weld in the horizontal position on 10 through 16 gauge sheet metal using GMAW.
   h. Construct a tee joint fillet weld in the horizontal position on 10 through 16 gauge sheet metal using GMAW.
   i. Construct a lap joint fillet weld in the vertical position on 10 through 16 gauge sheet metal using GMAW.
   j. Construct a tee joint weld in the vertical position on 10 through 16 gauge sheet metal using GMAW.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6
2. Demonstrate the ability to safely use oxyacetylene welding on 10 through 16 gauge sheet metal.
   a. Identify safety rules for using oxyacetylene equipment.
   b. State elements of quality fusion welding on 10 through 16 gauge sheet metal.
   c. Light the oxyacetylene torch and adjust for carburizing, neutral, and oxidizing flames.

d. Run a fusion bead.
e. Tack weld two pieces of plate.
f. Weld a butt joint with 1/16" cap using 16 gauge black iron.
g. Weld a lap joint.
h. Weld a tee joint.
i. Weld flame joints with a filler rod.
j. Weld flame joints without a filler rod.

Related Academic Topics (See Appendix A): C1, C4, C5
Workplace Skills (See Appendix B): WP2, WP3, WP5

3. Demonstrate the ability to safely do basic sheet metal brazing.
   a. Identify safety rules.
   b. Braze a lap joint on sheet metal.
   c. Braze a tee joint on sheet metal.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP5
4. Demonstrate the ability to safely use basic oxyacetylene cutting.
   a. Identify safety rules.
   b. Attach a cutting torch, light, and adjust to a cutting flame.
   c. Cut along a straight line.
   d. Cut arcs and circles.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6
5. Demonstrate the ability to safely use basic plasma arc cutting (PAC).
   a. Identify safety rules for using plasma arc cutting (PAC).
   b. Define the principles of plasma arc cutting.
   c. Identify the machine controls on a plasma arc cutting machine.
   d. Identify the parts of a plasma arc cutting torch and explain their functions.
   e. Cut thin galvanized metal using PAC.
   f. Cut mild steel using PAC.
   g. Cut aluminum using PAC.
   h. Cut stainless steel using PAC.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6
6. Demonstrate the ability to safely use tungsten inert gas (TIG).
   a. Identify safety rules.
   b. Weld stainless steel.
   c. Weld aluminum.

   Related Academic Topics (See Appendix A): C1, C4, C5
   Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6
7. Demonstrate the ability to safely use basic shielded metal arc welding (SMAW).
   a. Set up and safely use shielded metal arc equipment for sheet metal welding.

b. Strike and maintain an arc.
c. Run a stringer bead.
d. Weld a single pass fillet joint.
e. Identify the basic welding positions used for sheet metal welding.
f. Identify the basic welding joints for use in sheet metal welding.
g. Weld a single pass butt joint with a 1/16" cp on thin metal (16 gauge black iron).

Related Academic Topics (See Appendix A): C1, C4, C5
Workplace Skills (See Appendix B): WP2, WP3, WP5, WP6

Course Name: Machine Processes II

Course Abbreviation: SMV 1523

Classification: Vocational-Technical Elective

Description: This course is a continuation of Machine Processes I and includes the use of power-operated machines of the sheet metal trade. (3 sch: 1 hr. lecture, 4 hr. lab)

Prerequisites: Machine Processes I (SMV 1513)

Competencies and Suggested Objectives:

1. Demonstrate the ability to safely use the press brake.
   a. Form metal of 10 to 30 gauge at 30, 45, 60, and 90 degrees.
   Related Academic Topics (See Appendix A): C1, C4, C5, M4
   Workplace Skills (See Appendix B): WP2, WP3, WP6
2. Demonstrate the ability to safely use the power shears.
   a. Cut a full length of the sheet.
   b. Square metal.
   c. Cut gussets.
   Related Academic Topics (See Appendix A): C1, C4, C5, M4
   Workplace Skills (See Appendix B): WP2, WP3, WP6
3. Demonstrate the ability to safely use the iron worker processes.
   a. Cut flat stock.
   b. Cut round stock.
   c. Cut angle iron.
   d. Punch holes.
   e. Notch metal.
   Related Academic Topics (See Appendix A): C1, C4, C5, M4
   Workplace Skills (See Appendix B): WP2, WP3, WP6
4. Demonstrate the ability to safely use the cleat bender process.
   a. Turn drive seam, flat metal.
   b. Turn drive seam, one piece duct.
   c. Turn drive seam, "L" shaped duct.
   Related Academic Topics (See Appendix A): C1, C4, C5, M4
   Workplace Skills (See Appendix B): WP2, WP3, WP4
5. Demonstrate the ability to safely use the power rotary machine process.
   a. Form a single bead on a weather band.
   b. Form an ogee bead on round pipe.
   c. Crimp a round pipe with an ogee bead.

d. Crimp and bead a cylindrically-shaped cone.
e. Turn an edge for a gin elbow using thick edge rolls.

Related Academic Topics (See Appendix A): C1, C4, C5, M4
Workplace Skills (See Appendix B): WP2, WP3, WP5

6. Demonstrate the ability to safely use the power rolls process.
   a. Roll round pipe for gin use (18 to 20 gauge galvanized).
   b. Roll band iron for back-up plates.
   c. Roll cold rolled round stock.
   d. Roll tapered shapes for a reducer.

   Related Academic Topics (See Appendix A): C1, C4, C5, M4
   Workplace Skills (See Appendix B): WP2, WP3, WP5
7. Demonstrate the ability to safely use the power bender process.
   a. Roll square stock.
   b. Roll square tubing.
   c. Roll round tubing.
   d. Roll round stock.
   e. Roll band iron.

   Related Academic Topics (See Appendix A): C1, C4, C5, M 4
   Workplace Skills (See Appendix B): WP2, WP3, WP6

Course Name: Special Project in Sheet Metal

Course Abbreviation: SMV 291(1-3)

Classification: Vocational-Technical Elective

Description: This course is designed to provide the student with practical application of skills and knowledge gained in other technical courses. The instructor works closely with the student to insure that the selection of a project will enhance the student's learning experience. (1-3 sch: 2-6 hr. lab)

Prerequisites: Consent of Instructor

Competencies and Suggested Objectives:

1. Develop a written plan which details the activities and projects to be completed.
   a. Utilize a written plan which details the activities and projects to be completed.
   b. Perform written occupational objectives in the special project.

   Related Academic Topics (See Appendix A): C5, C6
   Workplace Skills (See Appendix B): WP1, WP6
2. Assess accomplishment of objectives.
   a. Prepare daily written assessment of accomplishment of objectives.
   b. Present weekly written reports to instructor in activities performed and objectives accomplished.

   Related Academic Topics (See Appendix A): C5, C6
   Workplace Skills (See Appendix B): WP6
3. Utilize and follow a set of written guidelines for the special project.
   a. Develop and follow a set of written guidelines for the special project.

   Related Academic Topics (See Appendix A): C5, C6
   Workplace Skills (See Appendix B): WP1, WP6

Course Name: Work-Based Learning in Sheet Metal

Course Abbreviation: SMV 292(1-6)

Classification: Vocational-Technical Elective

Description: This course is a cooperative program between industry and education and is designed to integrate the student's studies with industrial experience. Variable credit is awarded on the basis of semester hour per 45 industrial contact hours. (1-6 sch: 3-18 hr. externship)

Prerequisites: Consent of instructor

Competencies and Suggested Objectives:

1. Apply technical skills needed to be a viable member of the work force.
   a. Prepare a description of technical skills to be developed.
   b. Develop technical skills needed to be a viable member of the work force.
   Related Academic Topics (See Appendix A): C4, C5
   Workplace Skills (See Appendix B): WP1
2. Apply skills developed in other program area courses.
   a. Perform skills developed in other program area courses.
   Related Academic Topics (See Appendix A): C4, C5
   Workplace Skills (See Appendix B): WP6
3. Apply human relationship skills.
   a. Practice human relationship skills in the program.
   Related Academic Topics (See Appendix A): C6
   Workplace Skills (See Appendix B): WP3
4. Apply and practice positive work habits and responsibilities.
   a. Perform assignments to develop positive work habits and responsibilities.
   Related Academic Topics (See Appendix A): C5, C6
   Workplace Skills (See Appendix B): WP3
5. Work with instructor and employer to develop written occupational objectives to be accomplished.
   a. Perform written occupational objectives.
   Related Academic Topics (See Appendix A): C5
   Workplace Skills (See Appendix B): WP6
6. Assess accomplishment of objectives.
   a. Prepare daily written assessment of accomplishment of objectives.
   b. Present weekly written reports to instructor in activities performed and objectives accomplished.
   Related Academic Topics (See Appendix A): C5
   Workplace Skills (See Appendix B): WP6

7. Utilize a set of written guidelines.
   a. Develop and follow a set of written guidelines.
   Related Academic Topics (See Appendix A): C5
   Workplace Skills (See Appendix B): WP6

RELATED VOCATIONAL-TECHNICAL COURSES

Course Name: Principles of CAD

Course Abbreviation: DDT 1313

Classification: Related Vocational-Technical (From Drafting and Design Technology)

Description: This course will introduce the student to the operating system and how to perform basic drafting skills on the CAD. (3 sch: 2 hr. lecture, 2 hr. lab)

Prerequisites: None

Competencies and Suggested Objectives:

1. Demonstrate the ability to manage the operating system.
   a. Format, label, and examine the contents of floppy disks.
   b. List, erase, rename, and copy files on floppy and hard disks.
   c. Create, remove, and move files between directories and subdirectories.
   d. Set the date and time on the computer.
   e. Examine the contents of files.

   Related Academic Topics (See Appendix A): C2, C3, C5, C6, M2, M3, M5, M7, S8

   Workplace Skills (See Appendix B): WP2, WP5, WP6
2. Demonstrate the ability to use the basic hardware of the CAD system.
   a. Input data using keyboard, graphics tablet, and mouse.
   b. Access files and/or symbols from the hard disk.
   c. Store, retrieve, copy, and delete drawings and files.

   Related Academic Topics (See Appendix A): C2, C3, C5, C6, M2, M3, M5, M7, S8

   Workplace Skills (See Appendix B): WP2, WP5, WP6
3. Demonstrate the ability to perform drafting functions on the CAD system.
   a. Construct a drawing using the draw command.
   b. Produce a drawing utilizing the construct command.
   c. Utilize the modify commands.
   d. Utilize the settings variables.

   Related Academic Topics (See Appendix A): C2, C3, C5, C6, M2, M3, M5, M7, S8

   Workplace Skills (See Appendix B): WP2, WP5, WP6

SECTION III:

RECOMMENDED TOOLS AND EQUIPMENT

RECOMMENDED TOOLS AND EQUIPMENT FOR SHEET METAL PROGRAMS

1. Student tool box (1) containing the following:
   - Right-handed aviation snips (1)
   - Left-handed aviation snips (1)
   - Bulldog aviation snips (1)
   - Straight snips, 4" (1)
   - Combination blade snips (1)
   - Hand seamer (1)
   - Hand crimper (1)
   - 12 wing divider (1)
   - Flat head screwdriver (1)
   - Phillips screwdriver (1)
   - 48" Circumference rule (1)
   - Framing square (1)
   - Combination square, 12" (1)
   - Scratch awl (1)
   - Slip joint pliers, 8" (1)
   - Vise grip pliers, 8" (1)
   - Rawhide mallet (1)
   - ¼" Screw chuck (1)
2. Trammel set (Quick action) (5)
3. Beam compass (5)
4. ⅜" variable speed reversible hand drill (with bits) (5)
5. ½" variable speed reversible hand drill (with bits) (2)
6. 9" Hand grinders (2)
7. 4" Hand grinders (2)
8. Sawsall (1)
9. Portable band saw (hand) (1)
10. 14" Chop saw (1)
11. Hand hacksaws with blades (5)
12. 10" Adjustable wrenches (5)
13. Vise grip C-clamps (10)
14. Bar clamps (2)
15. Assorted C-clamps (12)
16. Hand rivet tool (4)
17. Hand groover (¼" grove joint) (4)
18. Hand staple gun (insulation) (3)
19. ⅜" drive socket set (1)
20. Set, end wrenches through 1" (1)
21. Angle finders (2)
22. Safety glasses cabinet with safety glasses (1)
23. Velometer (air flow meter) (1)

24. Water column (negative pressure gage) (1)
25. Metal gage (4)
26. Micrometer, 1" (2)
27. Veneer micrometer, 1" (1)
28. Ballpeen hammers, 12 and 16 oz. (4)
29. 2 lb. Shop hammer (2)
30. 3 lb. Solder coper (6)
31. Air handling unit (1)
32. ½" Hammer drill (1)
33. Bench furnace (1)
34. Pop rivet gun (5)
35. Chisels (set) (1)
36. A-wire brushes – Stainless steel (5)
37. B-wire brushes – bench 18" (5)
38. Duct stretchers (2)
39. Nut drivers, ½" and 5/16" (5)
40. Levels 1@48", 2@24", 6@12" (9)
41. Welding hoods (5)
42. Welding goggles (5)
43. Welding gloves, pair (10)
44. Air compressor (1)
45. Extension electric cords, 3@25 ft., 2@50 ft. (5)
46. Grinding wheel dresser (1)
47. Pipe wrenches, 18" (2)
48. Bolt cutters, 24" (1)
49. Chipping hammers (6)
50. Layout table, 3' x 8' (10)
51. Horizontal band saw (1)
52. 10' cornice brake, 14 ga. capacity (hand brake) (1)
53. 4' box and pan break, 14 ga. capacity (1)
54. 10' 100 ton hydraulic brake with safety device (1)
55. 4' slip roll, 14 ga. capacity (3") (1)
56. 4' 14 ga. power slip roll with safety devices with pneumatic lock (1)
57. 4' cornice brake, 16 ga. capacity with stand (1)
58. 4' foot stamp shear, 16 ga. capacity (1)
59. 10', ¼" mechanical power shear with back read out (1)
60. Combination rotary machine, 20 ga. capacity with dies (hand operated) (2)
61. Easy edger, 20 ga. capacity (1)
62. Combination crimp and bead machine (hand operated) (1)
63. 20 ga., Pittsburgh machine, (7 station) with inboard rolls to be acme roll (pipe) (1)
64. 15" drill press (1)
65. Bench grinders, 8" (2)
66. Anvil with stand, 200 lb. (1)

67. Universal stake holder with stakes and stand (1)
68. Four piece set, hand dolly (1)
69. Oxy-acetylene sets (medium range) (4)
70. GMAW - SMAW combination welder (4)
71. TIG welders with torches (2)
72. Spot welder (1)
73. Plasma cutter (1)
74. 16 ga. Uni-shear (2)
75. 16 ga. Nibbler (1)
76. 6" vise (2)

RECOMMENDED INSTRUCTIONAL AIDS

1. Cart, AV (for overhead projector) (1)
2. Cart, AV (for TV-VCR) (1)
3. Computer with operating software with multimedia kit (1)
4. Printer, dot matrix (1)
5. TV-VCR (1)
6. Video out (microcomputer to TV monitor) (1)

APPENDIX A:

RELATED ACADEMIC TOPICS

APPENDIX A

RELATED ACADEMIC TOPICS FOR COMMUNICATIONS

C1 Interpret written material.
C2 Interpret visual materials (maps, charts, graphs, tables, etc.).
C3 Listen, comprehend, and take appropriate actions.
C4 Access, organize, and evaluate information.
C5 Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.
C6 Communicate ideas and information effectively using various oral and written forms for a variety of audiences and purposes.

EXPANDED TOPICS FOR COMMUNICATIONS

TOPIC C1: Interpret written material.

C1.01 Read and follow complex written directions.
C1.02 Recognize common words and meanings associated with a variety of occupations.
C1.03 Adjust reading strategy to purpose and type of reading.
C1.04 Use sections of books and reference sources to obtain information.
C1.05 Compare information from multiple sources and check validity.
C1.06 Interpret items and abbreviations used in multiple forms.
C1.07 Interpret short notes, memos, and letters.
C1.08 Comprehend technical words and concepts.
C1.09 Use various reading techniques depending on purpose for reading.
C1.10 Find, read, understand, and use information from printed matter or electronic sources.

TOPIC C2: Interpret visual materials (maps, charts, graphs, tables, etc.).

C2.01 Use visuals in written and in oral presentations.
C2.02 Recognize visual cues to meaning (layout, typography, etc.).
C2.03 Interpret and apply information using visual materials.

TOPIC C3: Listen, comprehend, and take appropriate action.

C3.01 Identify and evaluate orally-presented messages according to purpose.
C3.02 Recognize barriers to effective listening.
C3.03 Recognize how voice inflection changes meaning.
C3.04 Identify speaker signals requiring a response and respond accordingly.
C3.05 Listen attentively and take accurate notes.
C3.06 Use telephone to receive information.

C3.07 Analyze and distinguish information from formal and informal oral presentations.

TOPIC C4: Access, organize, and evaluate information.

C4.01 Distinguish fact from opinion.
C4.02 Use various print and non-print sources for specialized information.
C4.03 Interpret and distinguish between literal and figurative meaning.
C4.04 Interpret written or oral communication in relation to context and writer's point of view.
C4.05 Use relevant sources to gather information for written or oral communication.

TOPIC C5: Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.

C5.01 Select appropriate words for communication needs.
C5.02 Use reading, writing, listening, and speaking skills to solve problems.
C5.03 Compose inquiries and requests.
C5.04 Write persuasive letters and memos.
C5.05 Edit written reports, letters, memos, and short notes for clarity, correct grammar, and effective sentences.
C5.06 Write logical and understandable statements, phrases, or sentences for filling out forms, for correspondence or reports.
C5.07 Write directions or summaries of processes, mechanisms, events, or concepts.
C5.08 Select and use appropriate formats for presenting reports.
C5.09 Convey information to audiences in writing.
C5.10 Compose technical reports and correspondence that meet accepted standards for written communications.

TOPIC C6: Communicate ideas and information using oral and written forms for a variety of audiences and purposes.

C6.01 Give complex oral instructions.
C6.02 Describe a business or industrial process/mechanism.
C6.03 Participate effectively in group discussions and decision making.
C6.04 Produce effective oral messages utilizing different media.
C6.05 Explore ideas orally with partners.
C6.06 Participate in conversations by volunteering information when appropriate and asking relevant questions when appropriate.
C6.07 Restate or paraphrase a conversation to confirm one's own understanding.
C6.08 Gather and provide information utilizing different media.

C6.09 Prepare and deliver persuasive, descriptive, and demonstrative oral presentations.

RELATED ACADEMIC TOPICS FOR MATHEMATICS

M1 Relate number relationships, number systems, and number theory.
M2 Explore patterns and functions.
M3 Explore algebraic concepts and processes.
M4 Explore the concepts of measurement.
M5 Explore the geometry of one-, two-, and three-dimensions.
M6 Explore concepts of statistics and probability in real world situations.
M7 Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

EXPANDED TOPICS FOR MATHEMATICS

TOPIC M1: Relate number relationships, number systems, and number theory.

M1.01 Understand, represent, and use numbers in a variety of equivalent forms (integer, fraction, decimal, percent, exponential, and scientific notation) in real world and mathematical problem situations.
M1.02 Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.
M1.03 Understand and apply ratios, proportions, and percents in a wide variety of situations.
M1.04 Investigate relationships among fractions, decimals, and percents.
M1.05 Compute with whole numbers, fractions, decimals, integers, and rational numbers.
M1.06 Develop, analyze, and explain procedures for computation and techniques for estimations.
M1.07 Select and use an appropriate method for computing from among mental arithmetic, paper-and-pencil, calculator, and computer methods.
M1.08 Use computation, estimation, and proportions to solve problems.
M1.09 Use estimation to check the reasonableness of results.

TOPIC M2: Explore patterns and functions.

M2.01 Describe, extend, analyze, and create a wide variety of patterns.
M2.02 Describe and represent relationships with tables, graphs, and rules.
M2.03 Analyze functional relationships to explain how a change in one quantity results in a change in another.
M2.04 Use patterns and functions to represent and solve problems.
M2.05 Explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations.

M2.06 Use a mathematical idea to further their understanding of other mathematical ideas.
M2.07 Apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, and business.

TOPIC M3: Explore algebraic concepts and processes.

M3.01 Represent situations and explore the interrelationships of number patterns with tables, graphs, verbal rules, and equations.
M3.02 Analyze tables and graphs to identify properties and relationships and to interpret expressions and equations.
M3.03 Apply algebraic methods to solve a variety of real world and mathematical problems.

TOPIC M4: Explore the concepts of measurement.

M4.01 Estimate, make, and use measurements to describe and compare phenomena.
M4.02 Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.
M4.03 Extend understanding of the concepts of perimeter, area, volume, angle measure, capacity, and weight and mass.
M4.04 Understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs.

TOPIC M5: Explore the geometry of one-, two-, and three-dimensions.

M5.01 Identify, describe, compare, and classify geometric figures.
M5.02 Visualize and represent geometric figures with special attention to developing spatial sense.
M5.03 Explore transformations of geometric figures.
M5.04 Understand and apply geometric properties and relationships.
M5.05 Classify figures in terms of congruence and similarity and apply these relationships.

TOPIC M6: Explore the concepts of statistics and probability in real world situations.

M6.01 Systematically collect, organize, and describe data.
M6.02 Construct, read, and interpret tables, charts, and graphs.
M6.03 Develop an appreciation for statistical methods as powerful means for decision making.
M6.04 Make predictions that are based on exponential or theoretical probabilities.

M6.05 Develop an appreciation for the pervasive use of probability in the real world.

TOPIC M7: Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

M7.01 Use computers and/or calculators to process information for all mathematical situations.
M7.02 Use problem-solving approaches to investigate and understand mathematical content.
M7.03 Formulate problems from situations within and outside mathematics.
M7.04 Generalize solutions and strategies to new problem situations.

RELATED ACADEMIC TOPICS FOR SCIENCE

S1 Explain the Anatomy and Physiology of the human body.
S2 Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.
S3 Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.
S4 Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.
S5 Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.
S6 Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.
S7 Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance, population genetics, the structure and function of DNA, and current applications of DNA technology.
S8 Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

EXPANDED TOPICS FOR SCIENCE

TOPIC S1: Explain the Anatomy and Physiology of the human body.

S1.01 Recognize common terminology and meanings.
S1.02 Explore the relationship of the cell to more complex systems within the body.

S1.03 Summarize the functional anatomy of all the major body systems.
S1.04 Relate the physiology of the major body systems to its corresponding anatomy.
S1.05 Compare and contrast disease transmission and treatment within each organ system.
S1.06 Explore the usage of medical technology as related to human organs and organ systems.
S1.07 Explain the chemical composition of body tissue.

TOPIC S2: Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.

S2.01 Identify the major types and structures of plants, viruses, monera, algae protista, and fungi.
S2.02 Explain sexual and asexual reproduction.
S2.03 Describe the ecological importance of plants as related to the environment.
S2.04 Analyze the physical chemical and behavioral process of a plant.

TOPIC S3: Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.

S3.01 Explain the morphology, anatomy, and physiology of animals.
S3.02 Describe the characteristics, behaviors, and habitats of selected animals.

TOPIC S4: Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.

S4.01 Examine minerals and their identification, products of the rock cycle, byproducts of weathering, and the effects of erosion.
S4.02 Relate the Hydrologic Cycle to include groundwater its zones, movement, and composition; surface water systems, deposits, and runoff.
S4.03 Consider the effects of weather and climate on the environment.
S4.04 Examine the composition of seawater; wave, tides, and currents; organisms, environment, and production of food; energy, food and mineral resources of the oceans.

TOPIC S5: Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.

S5.01 Examine the science of chemistry to include the nature of matter, symbols, formulas and nomenclature, and chemical equations.

S5.02 Identify chemical reactions including precipitation, acids-bases, and reduction-oxidation.
S5.03 Explore the fundamentals of chemical bonding and principles of equilibrium.
S5.04 Relate the behavior of gases.
S5.05 Investigate the structure, reactions, and uses of organic compounds; and investigate nuclear chemistry and radiochemistry.

TOPIC S6: Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.

S6.01 Examine fundamentals of motion of physical bodies and physical dynamics.
S6.02 Explore the concepts and relationships among work, power, and energy.
S6.03 Explore principles, characteristics, and properties of electricity, magnetism, light energy, thermal energy, and wave energy.
S6.04 Identify principles of modern physics related to nuclear physics.

TOPIC S7: Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance; population genetics, the structure and function of DNA, and current applications of DNA technology.

S7.01 Examine principles, techniques, and patterns of traits and inheritance in organisms.
S7.02 Apply the concept of population genetics to both microbial and multicellular organism.
S7.03 Identify the structure and function of DNA and the uses of DNA technology in science, industry, and society.

TOPIC S8: Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

S8.01 Apply the components of scientific processes and methods in classroom and laboratory investigations.
S8.02 Observe and practice safe procedures in the classroom and laboratory.
S8.03 Demonstrate proper use and care for scientific equipment.
S8.04 Investigate science careers, and advances in technology.
S8.05 Communicate results of scientific investigations in oral, written, and graphic form.

APPENDIX B:

WORKPLACE SKILLS

APPENDIX B
WORKPLACE SKILLS FOR THE 21ST CENTURY

WP1 Allocates resources (time, money, materials and facilities, and human resources).

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.

WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.

WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.

WP5 Selects, applies, and maintains/troubleshoots technology.

WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.

APPENDIX C:

STUDENT COMPETENCY PROFILE

STUDENT COMPETENCY PROFILE FOR SHEET METAL PROGRAMS

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each course. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the program.

In the blank before each competency, place the date on which the student mastered the competency.

Orientation and Shop Safety (SMV 1112)

_____ 1. Describe local program and school policies and procedures.
_____ 2. Describe employment opportunities and responsibilities.
_____ 3. Describe personal safety rules for working in the sheet metal industry.

Measurement (SMV 1212)

_____ 1. Demonstrate the ability to use various measuring tools used in the sheet metal industry.
_____ 2. Demonstrate the ability to lay out different shapes and calculate unknown volumes and air movements.
_____ 3. Demonstrate that ability to perform basic drawing skills.

Methods of Layout I (SMV 1315)

_____ 1. Demonstrate the ability to lay out and develop various sheet metal problems using the principles of parallel line and triangulation development.
_____ 2. Demonstrate the ability to lay out and develop sheet metal problems using the principles of parallel line.
_____ 3. Demonstrate the ability to lay out and develop sheet metal problems using the principles of triangulation.

Hand Processes I (SMV 1414)

_____ 1. Demonstrate the ability to perform layout processes.
_____ 2. Demonstrate the ability to utilize the cutout processes.
_____ 3. Demonstrate the ability to do forming processes.
_____ 4. Demonstrate the ability to use the various fastening processes.
_____ 5. Demonstrate the ability to apply the various finishing processes.

Machine Processes I (SMV 1513)

_____ 1. Demonstrate the ability to safely use the cornice brake.
_____ 2. Demonstrate the ability to safely use the slip-roll forming machine.
_____ 3. Demonstrate the ability to safely use the foot squaring shears.
_____ 4. Demonstrate the ability to safely use the hand combination rotary machine.
_____ 5. Demonstrate the ability to safely use the drill press.
_____ 6. Demonstrate the ability to safely use the bench or floor grinders.
_____ 7. Demonstrate the ability to safely use the disc sanders and buffers.
_____ 8. Demonstrate the ability to safely use the box and pan brake machine.
_____ 9. Demonstrate the ability to safely use the Pittsburgh machine.
_____ 10. Demonstrate the ability to safely use a spot welder.
_____ 11. Demonstrate the ability to safely use the metal cutting band saw.
_____ 12. Demonstrate the ability to safely use the setting down machine.
_____ 13. Demonstrate the ability to safely use the easy edger.
_____ 14. Demonstrate the ability to safely use the turret punch.

Methods of Layout II (SMV 1326)

_____ 1. Demonstrate the ability to safely fabricate and install architectural/roofing sheet metal.
_____ 2. Demonstrate the ability to safely fabricate and install specialty sheet metal.
_____ 3. Demonstrate the ability to lay out and develop sheet metal problems using the principles of radial line.

Hand Processes II (SMV 1424)

_____ 1. Demonstrate the ability to safely determine and make various layouts.
_____ 2. Demonstrate the ability to safely make cutouts of various shapes and materials.
_____ 3. Demonstrate the ability to safely form various special projects.
_____ 4. Demonstrate the ability to safely use fastening techniques.
_____ 5. Demonstrate the ability to safely finish welds.

Sheet Metal Welding (SMV 1613)

_____ 1. Demonstrate the ability to safely use gas metal arc welding (GMAW).
_____ 2. Demonstrate the ability to safely use oxyacetylene welding on 10 through 16 gauge sheet metal.
_____ 3. Demonstrate the ability to safely do basic sheet metal brazing.
_____ 4. Demonstrate the ability to safely use basic oxyacetylene cutting.

_____ 5. Demonstrate the ability to safely use basic plasma arc cutting (PAC).
_____ 6. Demonstrate the ability to safely use tungsten inert gas (TIG).
_____ 7. Demonstrate the ability to safely use basic shielded metal arc welding (SMAW).

Machine Processes II (SMV 1523)

_____ 1. Demonstrate the ability to safely use the press brake.
_____ 2. Demonstrate the ability to safely use the power shears.
_____ 3. Demonstrate the ability to safely use the iron worker processes.
_____ 4. Demonstrate the ability to safely use the cleat bender process.
_____ 5. Demonstrate the ability to safely use the power rotary machine process.
_____ 6. Demonstrate the ability to safely use the power rolls process.
_____ 7. Demonstrate the ability to safely use the power bender process.

Special Project in Sheet Metal (SMV 291(1-3))

_____ 1. Develop a written plan which details the activities and projects to be completed.
_____ 2. Assess accomplishment of objectives.
_____ 3. Utilize and follow a set of written guidelines for the special project.

Work-Based Learning in Sheet Metal (SMV 292(1-6))

_____ 1. Apply technical skills needed to be a viable member of the work force.
_____ 2. Apply skills developed in other program area courses.
_____ 3. Apply human relationship skills.
_____ 4. Apply and practice positive work habits and responsibilities.
_____ 5. Work with instructor and employer to develop written occupational objectives to be accomplished.
_____ 6. Assess accomplishment of objectives.
_____ 7. Utilize a set of written guidelines.